

CHAPTER 8

COPYING

The term *copying*, as used in photography, means producing a photograph from a photograph, map, painting, or similar flat document. A document that is copied is called the “copy original” or “original,” and the products of the copying process are called “reproductions*” or “copies.” Originals are broadly classed as reflection originals and transparent originals. The photographic reproduction can be any size in relation to the original document.

Copying is a large and important part of naval photography. It provides an important service to most every aspect of the Navy—from the Intelligence Specialist giving a training lecture, to the admiral who needs 100 copies of a map for planning an invasion.

Photographic copying is an accurate, inexpensive, and quick way of reproducing originals. Copying is skilled work and you must give it the same careful attention that you give to other types of photography. Making good photographic copies is an accomplishment any photographer can be proud of. A knowledge of copying techniques extends your skill as a Navy photographer and makes you more useful to yourself and the Navy.

The process of copying is complicated by the extensive variation in the type of originals to be copied and the varying conditions under which the work is done. The materials to be copied range from simple line drawings to transparencies that are used daily aboard ship and at shore stations. Films used for copy photography are processed much the same as films for other photography. They can be processed by hand, in trays and tanks, or processed by machine.

COPY TERMINOLOGY

Copying—Photographing flat documents, such as photographs, drawings, blueprints, charts, and so forth.

Original—Material from which copies are made, such as handwritten copy, typed copy, printed matter, tracings, drawings, and photographs.

Halftone—Reproduction by printing processes, such as lithography of a photograph in which the gradation of tone is reproduced by a pattern of dots and intermittent white spaces, caused by interposing a halftone screen between the lens and the film. (See fig. 8-1.)

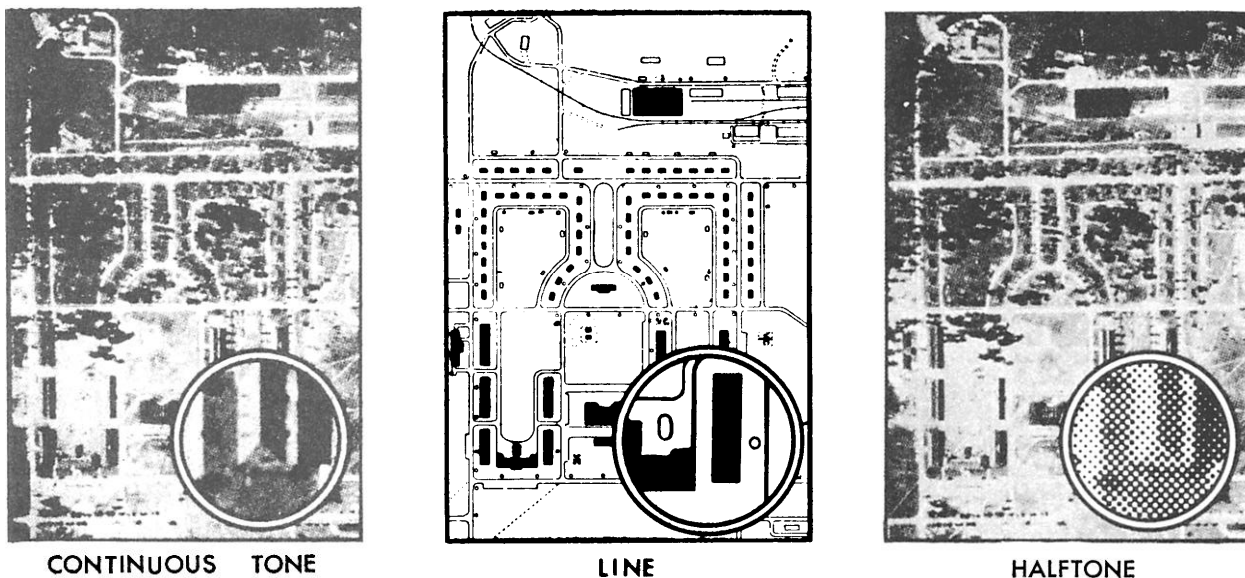


Figure 8-1.—Comparison of continuous tone, line, and halftone.

Line Original—A document or drawing consisting essentially of two tones (such as black and white, black and tinted, or brown and buff) without intermediate tones.

Continuous-Tone Original—Materials in which the detail and tone values of the subject are reproduced by an infinite gradation of gray densities between white and black

Copy Negative—A photographic film negative made as an intermediate from which prints are made.

Reproduction—The duplication of original copy by any photographic process.

Copyboard—The board, easel, frame, or other device for holding originals to be copied.

Reflex Copying—A method of contact printing in which light passes through the sensitized paper and emulsion, strikes the material being copied, and reflects back to the emulsion, producing a reversed reproduction of the original.

Restoration-Copying old, faded, or damaged material to produce a more presentable or legible copy.

Duplicating-Producing copies of negatives or slides for use instead of the originals.

Intermediate Positive—A positive transparency of a negative used for making more negatives.

Intermediate Negative (Interneg)—A negative made from a positive transparency that is then used to make reflection prints.

COPYRIGHT

On January 1, 1978, a new copyright statute came into effect in the United States. Some highlights from the law are given here. For specific details about the law or to gain copies of the statute and regulations, send a specific written request to the following: Copyright Office, Library of Congress, Washington, DC 20559.

Copyright Protection

Copyright is a form of protection provided by the laws of the United States to the authors of “original works of authorship” including photographs. This protection is available to both published and unpublished works. The Copyright Act generally gives the owner of the copyright the exclusive right to do and to authorize others to do the following:

- To reproduce the copyrighted work

- To prepare *derivative works* based upon the copyrighted work
- To distribute copies of the copyrighted work to the public by sale or other transfer of ownership or by rental, lease, or lending
- To display the copyrighted work publicly in the case of literary, musical, dramatic, and choreographic, or sculptural works, including the individual images of a motion picture or other photographic work

It is illegal for *anyone* to violate the rights provided to an owner of a copyright. These rights, however, are not unlimited in scope. The Copyright Act establishes limitations on these rights. In some cases, these limitations are specified exemptions from copyright liability. Generally however, it is unlawful to reproduce, without written consent of the copyright owner, any material bearing a notice of copyright. The guiding rule in copying is to secure written permission from the copyright owner before starting work

What Is Protected

Copyright protection exists for original works of authorship when they become fixed in a tangible form of expression. The fixation does not need to be directly perceptible, so long as it may be communicated with the aid of a machine or device. Copyrightable works include the following categories:

- Literary works
- Musical works, including any accompanying words
- Dramatic works, including any accompanying music
- Pantomimes and choreographic works
- Pictorial, graphic, and sculptural works
- Motion pictures and other imaging works and sound recordings

This list is illustrative and is not inclusive of the categories of copyrightable works. These categories should be viewed quite broadly.

What Is Not Protected

Several categories of material are generally not eligible for statutory copyright protection. Among others include the following:

- Works that have not been fixed in a tangible form of expression
- Titles, names, short phrases, and slogans; familiar symbols or designs; mere variations of typographic ornamentation, lettering, or coloring; mere listings of ingredients or contents
- Ideas, procedures, methods, systems, processes, concepts, principles, discoveries, or devices, as distinguished from a description, explanation, or illustration
- Works consisting *entirely* of information that is common property and containing no original authorship; for example: standard calendars, height and weight charts, tape measures and rules, and lists or tables taken from public documents or other common sources

Copyright Secured Automatically upon Creation

The way that copyright protection is secured is frequently misunderstood. No publication or registration or other action in the Copyright Office is required to secure a copyright under the law. Copyright is secured *automatically* when the work is created, and a work is “created” when it is fixed in a copy or imaging recording for the first time. In general, “copies” are material objects from which a work can be read or visually perceived either directly or with the aid of a machine or device, such as books, manuscripts, sheet music, film, videotape, or microfilm. Phonograph records are material objects embodying fixations of sounds (excluding, by statutory definition, motion picture sound tracks), such as audio tapes and phonograph disks. Thus, for example, a song (the “work”) can be fixed in sheet music (copies) or in audio recordings, or both.

Notice of Copyright

When a work is published under the authority of the copyright owner, a notice of copyright should be placed on all publicly distributed copies. This notice is required even on works published outside of the United States. Omission or errors will not necessarily result in forfeiture of the copyright. Therefore, just because a copyrightable material does not have a copyright notice does not mean it is not copyrighted. However, infringers misled by the omission or error of copyright notice will be shielded from liability.

How Long Copyright Protection Lasts

The copyright law changed in 1978. The time that the copyright on original material expires is determined by when it was created.

WORKS ORIGINALLY COPYRIGHTED ON OR AFTER JANUARY 1, 1978.—A work that is created (fixed in tangible form for the first time) on or after January 1, 1978, is automatically protected from the moment of its creation. It is ordinarily given a term enduring for the author’s life, plus an additional 50 years after the author’s death. In the case of a joint work prepared by two or more authors that did not work for hire, the term lasts for 50 years after the last surviving author’s death. For works made for hire and for anonymous and pseudonymous (fictitious name) works (unless the author’s identity is revealed in Copyright Office records), the duration of copyright is 75 years from publication or 100 years from creation, whichever is shorter.

Works that were created before the 1978 law came into effect, but were neither published nor registered for copyright before January 1, 1978, have been automatically brought under the statute and are now provided federal copyright protection. The duration of copyright for these works is generally computed in the same way as for new works: the life plus 50 and the 75 or 100 year terms apply to them as well. However, all works in this category are guaranteed at least 25 years of statutory protection.

WORKS COPYRIGHTED BEFORE JANUARY 1, 1978.—Under the law in effect before 1978, copyright was secured either on the date a work was published or on the date of registration if the work was registered in unpublished form. In either case, the copyright endured for a first term of 28 years from the date it was secured. During the last (28th) year of the first term, the copyright was eligible for renewal. The new copyright law has extended the renewal term from 28 to 47 years for copyrights that were still in existence on January 1, 1978.

International Copyright Protection

There is no such thing as an “international copyright” that will automatically protect an author’s writings throughout the entire world. Protection against unauthorized use in a particular country depends, basically, on the national laws of that country. However, most countries do offer protection to foreign works under certain conditions, and these conditions have been greatly simplified by international copyright treaties and conventions.

The United States is a member of the Universal Copyright Convention (UCC). Generally, a work by a national or resident of a country that is a member of the UCC, or a work first published in a UCC country, may claim protection under the UCC.

Works of the United States Government

Works produced for the U. S. Government by its officers and employees as part of their official duties are not subject to U.S. copyright protection. The law makes it clear that this prohibition applies to unpublished works as well as published ones.

Fair Use

U.S. copyright laws specifically recognizes the principle of “fair use” as a limitation on the exclusive rights of copyright owners. The law considers factors in determining whether particular uses fall within this category. Listed below are the minimum standards of educational fair use of copyrighted works under the law. The guidelines are not intended to limit the types of copying permitted under the standards of fair use.

I. SINGLE COPYING FOR TEACHERS:

A single copy may be made of any of the following by or for a teacher at his or her individual request for his or her scholarly research or use in teaching or preparation to teach a class:

- A. A chapter from a book
- B. An article from a periodical or newspaper
- C. A short story, short essay, or short poem whether or not it is from a collective work
- D. A chart, graph, diagram, drawing, cartoon, or picture from a book, periodical, or newspaper.

II. MULTIPLE COPIES FOR CLASSROOM USE:

Multiple copies (not to exceed in any event more than one copy per pupil in a course) may be made by or for the teacher giving the course for classroom use or discussion *provided that*:

- A. The copying meets the test of brevity and spontaneity as defined below; and,
- B. Meets the cumulative effect test as defined below; and,
- C. Each copy includes a notice of copyright.

III. PROHIBITIONS AS TO I AND II ABOVE:

Notwithstanding any of the above, the following shall be prohibited:

A. Copying shall not be used to create or to replace or substitute for anthologies, compilations, or collective works. Such replacement or substitution may occur whether copies of various works or excerpts therefrom are accumulated or are reproduced and used separately.

B. There shall be no copying of or from works intended to be “consumable” in the course of study or of teaching. These include workbooks, exercises, standardized tests, and test booklets and answer sheets and like consumable material.

C. Copying shall not:

- 1. substitute for the purchase of books, publisher’s reprints, or periodicals;
- 2. be directed by higher authority; and
- 3. be repeated with respect to the same item by the same teacher from term to term.

D. No charge shall be made to the student beyond the actual cost of the photocopying.

Each Navy photo lab should have a copy of SECNAVINST 5870.5, *Permission to use Copyrighted Materials in the Department of the Navy*. All Photographer’s Mates should be familiar with its general content. It should be the basic instruction you should use when the question of copyright comes up. Here are a few excerpts from the instruction:

“As a general proposition, copyrighted works may not be used without permission of the copyright owner. Unauthorized use is a copyright infringement, . . . the U.S. Government has no general exemption from copyright infringement liability. Government employees are not, however, personally liable for copyright infringement occurring in the performance of their official duties.”

“. . . it is a criminal offense to remove or alter any notice of copyright appearing on a . . . copyrighted work, . . .”

COPY RESTRICTIONS

Federal laws regulating photography are intended to prevent counterfeiting and fraud and are located generally in Title 18 of the United States Code.

Designated government officials are charged with safeguarding the nation’s currency. It is the belief of the United States Secret Service that granting permission to photograph and reproduce pictures of money, in color,

DEFINITIONS:

Brevity :

1. Poetry: (a) A complete poem if less than 250 words and if printed on not more than two pages, or (b) from a longer poem, and an excerpt of not more than 250 words.

2. Prose: (a) Either a complete article, story, essay of less than 2,500 words, or (b) an excerpt from any prose work of not more than 1,000 words or 10% of the work, whichever is less, but in any event a minimum of 500 words.

Each of the numerical limits stated in 1 and 2 above may be expanded to permit the completion of an unfinished line of a poem or of an unfinished prose paragraph.

3. Illustration: One chart, graph, diagram, drawing, cartoon or picture per book or per periodical issue.

4. "Special" works: Certain works in poetry, prose, or in "poetic prose" that often combine language with illustrations and which are intended sometimes for children and at other times for a more general audience that fall short of 2,500 words in their entirety. Paragraph 2 above notwithstanding such special works may not be reproduced in their entirety; however, an excerpt comprising not more than two of the published pages of such special work and containing not more than 10% of the words found in the text thereof, may be reproduced.

Spontaneity:

1. The copying of the material is for only one course in the school in which the copies are made.

2. Not more than one short poem, article, story, essay or two excerpts may be copied from the same author, nor more than three from the same collective work or periodical volume during one class term.

3. There shall not be more than nine instances of such multiple copying for one course during one class term.

The limitations stated in 2 and 3 above shall not apply to current news periodicals and newspapers and current news sections of other periodicals.

seriously weakens the safeguards designed to protect our currency.

As a Navy Photographer's Mate, you may be asked to copy United States and foreign financial certificates, such as obligations and securities. These may be needed for anything from the station newspaper to criminal investigations.

Provided below is information and conditions under which you are permitted to make copies of United States and foreign obligations and securities.

Paper Money, Checks, and Bonds

Printed illustrations of paper money, checks, bonds, and other obligations and securities of the United States and foreign governments are allowed for educational, historical, and newsworthy purposes. Illustrations must be in black and white and must be less than 3/4 or more than 1 1/2 times the size of the genuine original. No individual facsimiles of such obligations are permitted, and no illustrations of paper money, checks, or bonds may be in color.

To be permissible, an illustration must be accompanied by educational, historical, or newsworthy information relating directly to the item that is illustrated. Illustrations used primarily for decorative or eye-catching purposes are not allowed.

Motion-picture film and slides of paper money, checks, bonds and other obligations and securities of the United States and foreign governments are permitted in black and white or in color for projection upon a screen or for use in telecasting. Treasury regulations permit the illustration of United States bonds in connection with a campaign for the sale of such bonds.

United States and Foreign Postage Stamps

Printed illustrations of canceled and uncanceled United States postage stamps are permissible for articles, books, journals, newspapers, educational, historical, and newsworthy purposes.

Black-and-white illustrations may be of any size. Colored illustrations of canceled United States postage stamps may be of any size. However, illustrations in color of uncanceled United States postage stamps must be less than 3/4 or more than 1 1/2 times the size of the genuine stamp.

Printed illustrations of canceled foreign stamps in black and white or color are permissible in any size and for any purpose.

Black-and-white and color illustrations of uncanceled foreign postage stamps are permitted for educational, historical and newsworthy purposes,

Black-and-white illustrations may be of any size, but color illustrations must be less than 3/4 or more than 1 1/2 times the size of the genuine stamp.

Motion picture films and slides of the United States and foreign postage stamps are permissible in black and white or in color for projection upon a screen or for use in telecasting.

Revenue Stamps

Regulations for printed illustrations of United States and foreign revenue stamps are the same as for postage stamps, except colored illustrations of United States revenue stamps are not permitted.

Coins

Photographs or printed illustrations, motion-picture film or slides of the United States and foreign coins may be used for any purpose.

With few exceptions, existing law generally prohibits the manufacture, sale or use of any token, disk, or device in the likeness or similitude of any coins of the United States or of any foreign country that are issued as money.

Title 18, U.S. Code, Section 481

Whoever, except by lawful authority as described in the foregoing, prints photographs, or makes, executes, or sells any engraving, photograph, print, or impression in the likeness of any genuine note, bond, obligation, or other security, or any part thereof, of any foreign government, bank, or corporation, shall be fined not more than \$5,000 or imprisoned not more than 5 years, or both.

Destruction of Prints and Negatives

The negatives and prints of any United States obligation or foreign obligations produced for any of the purposes mentioned previously in this chapter must be destroyed after their final use.

COPY EQUIPMENT

The amount and type of copy work performed in an imaging facility should be the basis for the types of copy equipment on hand. When expensive equipment is not justified or available, a 35mm camera and the sun can be used for copying; however, the best results are obtained when cameras and equipment designed for copying are used.

Copying with a 35mm Camera

When making slides or only when an occasional copy job is requested, a 35mm camera should be used. Copy stands are available for use with 35mm cameras. (fig. 8-2) A set of lights may be mounted on the stand. When lights



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Figure 8-2.-Copy Stand.

are not provided with the copy stand, regular studio lights can be used in their place.

When a copy stand is not available for use with a 35mm camera, the camera can be used on a tripod, mounted for either horizontal or vertical copying. For vertical copying, the tripod elevator post is removed and inserted into the tripod upside down. The camera is then mounted under the tripod, and the tripod is then centered over the original to be copied.

Cameras for Copying Large Originals

When the copy work done in your lab is considerable and includes many large originals, the type of copy setup used by the graphic arts shops may be needed.

The type of camera used in graphic arts photography is called a process camera. Although larger than other types of cameras, it is similar in principle. Since the

process camera is built for copying, it has a copyboard and other features not associated with the average camera. There are two types of process cameras: horizontal and vertical.

Most horizontal process cameras are known as darkroom cameras because the camera back is built into the darkroom wall. Because the back of the camera extends into the darkroom and the front is housed in a separate room, you can load the film, focus the camera, make the exposure, and develop the film without leaving the darkroom. Of course, it is necessary for you or a helper to go outside to place copy in the copyboard before the exposure is made.

In recent years, vertical process cameras have become more popular because they take up much less floor space. This makes them especially useful aboard ship.

CAMERA ADJUSTMENTS.—Each copy camera has slightly different adjustments. You should consult the operating manual of your copy system to learn the proper operation and controls of your particular system. Only the minimum basic components of a copy system are discussed in this chapter.

GROUND GLASS FOCUSING.—Ground glass focusing is essential for exacting copy work. The image of a document viewed on the ground glass of a copy camera provides a means of monitoring all aspects of the image as it will appear in the reproduction. This includes image placement, image size, and any apparent unwanted reflections.

BELLOWS EXTENSION.—A copy camera should be capable of a bellows extension of at least two, and preferably three times or more the focal length of the lens being used. With a 3-inch lens and a bellows extension of two focal lengths (6 inches) and the original is positioned four focal lengths (12 inches) from the film plane, a 1:1 ratio of the original size to reproduction size is obtained. A reproduction with a 1:1 ratio can be referred to as “life size.” A bellows extension that is less than two focal lengths cannot produce an image as large or larger than the original. A bellows that can be extended more than two focal lengths can produce an image larger than the original.

LENSES FOR COPYING

A primary requirement for a lens used for copying is that it must focus sharply across a flat plan; that is, it must produce a sharp image over its entire field of view—all the way out to the edges of the image. In copying, the original has only two dimensions, and the loss of definition at the edges of the image is much more serious than it would be when photographing a three-dimensional subject.

Regular camera lenses of good quality can produce fair to good copy negatives. But most lenses for general photography are designed to focus at a flat field for distances greater than eight times the focal length. Since most copy work is done at close distances, the image field is not sharp because of the curvature of the general lens. This effect can be compensated for by stopping down the lens. However, because of the high degree of diffraction at small apertures, stopping down reduces the overall sharpness of the image. For critical copy work, such as when copying large, detailed originals, a lens designed for copying should be used. Such lenses, called process lenses, produce the best image at a lens-to-subject distance of about 10 feet or less.

Another very important aspect of a process lens is its evenness of illumination across the focal plane. Evenness of illumination across the entire negative is particularly important when copying line originals. The high-contrast films used to copy line originals have a short exposure latitude and any falloff in illumination results in obvious variations in exposure between the edges and the center of the negative.

For each lens there is an optimum aperture at which the lens produces the best image definition. For copy work, this optimum aperture should be used whenever possible. Since originals to be copied are flat or almost flat, an increase in depth of field by stopping down from the optimum aperture is not required or desired. With some lenses, especially process lenses, the optimum aperture and maximum aperture are the same. Generally, however, the optimum aperture is two full f/stops smaller than the maximum f/stop.

Most process lenses available today are apochromatic. They are designed to be free of chromatic aberrations; that is, they focus sharply all three primary colors in the same plane. Apochromatic lenses must be used for critical work in color copying and duplication.

Since exposure times in copy work are relatively long (i.e., seconds as compared to hundredths of a second), a lens equipped with a means of holding the shutter open is required. Your copy system must be completely free of vibration to obtain sharp images. For these long exposures, you must use the T and B settings and a cable release.

The focal length of a lens used for copying should be governed primarily by the size of the negative to be produced. For example, the focal length should be about equal to the diagonal measurement of the negative to be made. Therefore, when you are making 35mm negatives, use about a 1 3/4-inch or 45mm lens; a 4.5 x 6cm negatives, use a 3-inch or 75mm lens; and for 4 x 5 negatives, use a 6 1/4-inch or 160mm lens; and so on. In any case, you should use a lens that is longer than the film diagonal rather than a lens that is shorter. This way, you are taking advantage of the flatter field that is produced in the center area of the circle of illumination. A macro lens should be used when available because it is designed to produce sharp images at close planes.

COPYBOARD

Copyboards are an integral part of a copy system. The function of a copyboard is to hold the original flat and perfectly parallel to the lens and camera back. When the copyboard is not parallel, distortion results, and it

becomes difficult to get the entire subject in sharp focus. In some cases, the copyboard of the camera is a bed with a hinged glass cover. The original to be copied is placed on the bed and the glass cover is closed. When the cover is closed, the bed squeezes the original against the glass cover to flatten and hold it in place.

Reference lines are generally marked on the felt or rubber surface of the copyboard to aid in centering and aligning the copy. When the copyboard does not have these lines, draw your own on the copyboard or on a piece of paper and fasten it to the copyboard.

Some copyboards have a vacuum pump that provides suction to hold the copy flat to the copyboard. This eliminates the need for a glass cover. After the copy is placed on the copyboard, the pump is turned on and the vacuum holds the original in place.

When the copyboard does not have a vacuum pump or glass cover, originals can be held in place with pushpins. When it is not permissible to put holes in the edges of the original, then double-sided tape may be an alternative. When the copyboard is made of steel, the original can be held in place with bar magnets.

When a camera is not equipped with a copyboard and for occasional work, a copyboard can be made from a sheet of softwood or cork. The surface should be painted flat black, never white. A white, or even light-colored copyboard, reflects too much light into the camera lens, causing flare and troublesome reflections. Flare causes a loss in contrast and extra compression of the shadows. A black copyboard minimizes flare.

Always keep the glass of a copyboard clean. Dust it with a clean camel-hair brush and clean it with a soft cloth and glass cleaner. Never use dirty rags or razor blades to clean the glass. They may scratch it. When you have to scrape the glass, use your fingernail or an orange stick.

LIGHTING EQUIPMENT

Almost any type of light can be used for copy work, provided the intensity of the light is enough to prevent excessively long exposures. Another principle requirement of the light source is to produce a light with a color temperature suitable for the type of film being used.

Tungsten Lamps

Tungsten lamps 3200 K and 3400 K are suitable for normal black-and-white copy work. When a reflector type of bulb is used, the need for external reflectors is

eliminated. A lens shade should be used with a reflector type of bulb because the built-in reflector does not extend the full length of the bulb, and stray light may reach the lens and cause flare.

Lamps such as 3400 K are not as economical to use as 3200 K lamps because of their short life (4 to 6 hours).

Fluorescent Lights

When fluorescent tubes are used to light an original, they should be arranged to form a square—the sides of which are parallel to the edges of the copyboard. The size of the tubes and their distance from the copyboard are governed by the size of the original to be copied. Because this type of lighting setup is not easy to adjust, it is best used when the size of the originals to be copied does not vary much from one to another. Because of its diffused nature, fluorescent lighting is suitable for copying originals with a textured surface that must be eliminated in the finished print. Regular fluorescent lights should not be used when shooting color film because it is difficult to color correct them accurately. Special fluorescent lamps with a high color-rendering index (CRI) should be used whenever possible. When ordinary fluorescent lamps are used, consult the *Photo-Lab-Index* to determine what filter should be used as a starting point for the type of film you are using.

Electronic Flash

When used properly, electronic flash units are an excellent light source for copy photography. An electronic flash unit allows for extremely short exposures that can be helpful for shipboard photolabs when the ship is underway. The flash unit is balanced for daylight color film and does not produce the heat associated with tungsten or quartz bulbs.

Unless specifically designed for copy work and attached to the copyboard, electronic flash lamps may be difficult to position for proper illumination of the original. The task can be made easier if you use studio electronic flash units with built-in tungsten modeling lights. With this type of lighting unit, the modeling light can be used to position the lights accurately for even illumination of the original. Even with this, the light may have to be heavily diffused to prevent “hot spots.” A hot spot is a surface area that receives too much light, causing an unwanted reflection that is noticeable in the final copy product.

Quartz-Iodine Lamps

The quartz-iodine lamps (tungsten-halogen) are of the incandescent variety but bear little resemblance to conventional light bulbs. A quartz lamp is a short tube of quartz glass, housing a coiled filament that runs the length of the tube. In ordinary tungsten lamps, the tungsten evaporates from the filament and settles on the glass and gradually darkens the bulb. In the quartz-iodine lamp, however, iodine vapor combines chemically with the tungsten and causes it to redeposit on the filament. This prevents the tube from becoming tarnished with age. The intensity and color temperature of the tube remain almost constant throughout its life. Although the quartz-iodine lamp is very small, it produces intense light that is particularly suited for copy work. There is a disadvantage-quartz-iodine lamps generate extreme heat that could cause your original to curl. You should never touch a quartz-iodine lamp with your fingers. The oil from your hands can create a concentrated hot spot on the lamp, causing it to bubble and burn out.

LAMP REPLACEMENT.—As lamps get older, their color characteristics and light intensity may change. Therefore, when one lamp in a set burns out, the new replacement lamp is usually brighter and has a different color temperature than the remaining lamps. You should replace all the lamps, not just one to avoid the need for adjusting the new lamp to get even illumination. Replacement of all lamps in a set is particularly important when you are copying with color film because the color temperature of the new lamps is higher than the old lamps. The variation in color temperature would be seen as an uneven color quality over the resulting reproduction.

VOLTAGE VARIATIONS.—Fluctuations in the voltage or electric current affect the color temperature of copy lights. When the voltage to your copy lights varies, consult an electrician. The electrician can trace the source of fluctuation and recommend the best action to overcome the problem.

Parabolic Reflectors

An important element of the lighting equipment for copy work is the reflectors. Parabolic reflectors should cause the light to be evenly distributed over the surface area of the original and not cause hot spots. Certain types of lights, such as reflector photoflood lamps, have built-in reflectors. By use of the correct reflectors with artificial light sources, exposure times can be shortened.

Daylight

Daylight can be another excellent source of illumination for copying. When the sun is used, you should try to use the sun during the midday hours where a combination of daylight and skylight is present, because of the shifting of color temperature throughout the day. The early morning and evening hours should be avoided when color film is used, because the lack of blue light present. Heavy overcast skies or copying in shadow produces a bluish cast and should be avoided or corrected with a filter.

Filters

The use of filters was fully discussed in chapter 3. Both correction and contrast filters, as well as special filters, are used extensively in copy work

FILMS FOR COPYING

For copying, you can achieve the best results by selecting the correct film for the type of copy work to be done. Copy-type films are designed specifically to compensate for the compression that occurs in tone reproduction and it provides an improved highlight tonal separation. Copy films are available only in 70mm and sheet film formats. Although 35mm film can provide acceptable results, you should use sheet film since it provides higher-quality enlargements and is easier to retouch.

Film characteristics, such as color sensitivity and contrast, are important when you select the film to copy a specific type of original. Film characteristics were discussed in chapter 2.

SELECTING THE PROPER FILM

The following factors should be considered when choosing the proper film:

- The color of the original to be copied
- The contrast of the original
- The contrast of the film
- The type of product to be produced, that is, black-and-white or color print, duplicate negative, color or black-and-white transparency, and so on
- Color quality of the light source
- Types of film available

- Color sensitivity of the film
- Filters available

Black-and-White Line Originals

A black-and-white line original has no middle or intermediate tones between the lines and background. Therefore, the best film for copying black-and-white line originals is one with extreme contrast, such as Kodak Kodalith film. These films produce high contrast and extremely high density with an absence of fog, which ensures clear lines on a dense background.

Kodalith type of films have a very limited exposure latitude, and therefore, must be given very accurate exposure. Underexposure produces low-contrast negatives that result in prints having a muddy gray background instead of a clear, crisp, white background. Overexposure causes weak or very fine lines to fill in and results in a less than perfect transparency of the lines on the negative.

Typewritten material should be included in this type of original. When an original is typed or printed on thin white paper and on one side only, you should place another sheet of white paper behind the original to copy it. This increases the reflective ability of the original and increases contrast. When the original is printed or typed on both sides of thin white paper, place black paper behind the original to help prevent the printing or type on the reverse side of the original from showing through.

Colored Line Originals

In copying colored line originals to a black-and-white reproduction, you must maintain the high contrast between the lines and the background. This is best achieved by using a high-contrast panchromatic film, such as Kodak Contrast Process Pan film and a filter. When the lines or subject is to be rendered light against a dark background, the filter should transmit the color of the subject and absorb the color of the background. When the subject is to be rendered dark against a light background, the filter should absorb the color of the subject and pass the color of the background.

For example, a blueprint has white lines on a blue background. Copying the blueprint with Kodalith Pan film without a filter cannot produce maximum contrast because the film is highly sensitive to blue light and thus records the image of the blue background as a midtone of gray while recording the white line image as a dense highlight. When a red filter is used, the white lines still record as a dense highlight on the negative, but now the

blue background records as a shadow area because the red filter absorbs the blue light reflected from the blue background. Thus the background reproduces darker when a red filter is used.

Black-and-White Continuous-Tone Originals

To reproduce the tone gradation of a continuous-tone original, you must use a long-scale film. As discussed previously, a commercial type of film, such as Kodak Commercial film, is recommended.

The common fault in continuous-tone original copying is underexposure and overdevelopment. Full exposure with restrained development is the best rule for this type of work

Although appearing as line originals, handwritten material, pencil drawings, and so forth, are actually continuous-tone originals because of the midtones they contain. These should be copied as continuous-tone originals. Films, such as Kodak Professional Copy film or Kodak Commercial film, are recommended.

Colored Originals

When a black-and-white reproduction of multicolored reflection originals, such as color photographs, oil paintings, and so forth, is to be made, it should be copied with a moderate contrast, panchromatic film capable of recording numerous shades of gray. Panchromatic, long-scale film is recommended for copying this type of color original.

Colored originals are almost limitless in their degree of difference because of all the possible colors and hues. Each different colored original should be copied on the basis of what is desired in the black-and-white reproduction.

Color Reproduction of Color Originals

Selecting a film for copying colored reflection originals to make color reproductions is a matter of what type of reproduction is needed-reflection or transparency. Films, such as Kodak Vericolor III Professional Film Type L and Type S and Vericolor Internegative Film, can be used to produce color reflection copies. Color transparency film must be used to produce color transparencies from reflection originals. Some films have a different recommended ISO rating when used with tungsten or daylight light sources. Be sure to consult the data sheet supplied with the film or the *Photo-Lab Index* to determine the proper ISO setting.

When you are copying a color print to a color negative, the best film to use is Kodak Internegative film. Because of the inherent high contrast of photographic papers, if not controlled, contrast is gained in each generation of a reproduction. Kodak Internegative film is designed to give greater contrast separation in the highlights without raising the overall subject contrast in the negative. To achieve proper color balance in the shadows, midtones, and highlights, you must perform tests to assure that proper exposure and color filtration is obtained. The *Photo-Lab Index* contains the procedures necessary to accomplish this testing.

Combined Black-and-White Line and Continuous-Tone Originals

When a black-and-white original contains both line and continuous-tone matter, the ideal copy method is to copy each type of matter with an appropriate film separately and then sandwich the two negatives together, or print the two negatives separately on the same piece of paper. The colored lines should be copied with an extremely high contrast film, such as Kodalith Pan, and the pastel-colored portions of the original should be copied with a moderate contrast film.

When copying the original with only one type of film, you lose quality in either the lines or the continuous tones. For best results, you should copy the combined line and continuous-tone original with a moderate contrast film, such as Kodak Professional Copy film or Kodak Commercial film.

Black-and-White Halftone Originals

A black-and-white halftone original consists of a pattern of black dots of various sizes that represent tones of gray. Examples of halftone originals are printed pictures in newspapers or magazines. Small dots with ample white space between them produce an illusion of a light tone or highlight. Large dots that are close together produce the illusion of dark tones or shadow areas. Because the dots are all the same tone (black), halftone originals can be copied as line originals. This type of original can also be copied as a continuous-tone original, depending on the use of the final product.

Reflection Originals Specifically Produced for Copying

When an original is to be used specifically for copying, you can take certain measures to ensure better reproduction results.

PHOTOGRAPHIC PRINTS.—Black-and-white and color prints produced for copying should have normal density, color saturation, and a glossy surface. When a non-glossy surface is used, the texture of the surface may be apparent in the copy negative and reproductions.

TYPEWRITTEN MATERIAL.—Typewritten material that is to be copied should be typed with a new typewriter ribbon. A carbon “one time” ribbon is best. To further increase contrast between the type and the paper background, you can place a sheet of carbon paper behind the typing paper. This causes the carbon to be transferred onto the back of the paper during typing.

When using a typewriter to produce copy that will be photographed for making 35mm slides, limit your typing to no more than 8 double-spaced lines with 43 elite or 36 pica characters to a line. When photographing typed copy, use a template as a guide for setting up your camera. Allow about 1/8 inch of space outside the template lines in the camera viewfinder.

Originals with Defects

Occasionally, the only record of an event is the original document that through age or use is no longer in its original condition. By use of appropriate corrective measures, certain defects in originals can be eliminated or minimized in the reproduction.

WRINKLED OR CREASED ORIGINALS.—Reflection originals that are wrinkled or creased can be flattened by placing the original on a mounting board and then in a heated dry-mounting press. Mounting in this manner is permanent and should be considered carefully before being used.

Another method you can use to flatten an old photograph is to wet the photograph with water and squeegee it onto a sheet of glass with the emulsion toward the glass. The photograph must be removed from the glass before it dries; otherwise, it may stick to the glass.

STAINED BLACK-AND-WHITE ORIGINALS.—Usually, transparent stains on black-and-white originals can be eliminated in the reproduction by using panchromatic film and a filter that is the same color as the stain. Details on eliminating images of stains with filters is discussed in chapter 3.

FADED BLACK-AND-WHITE PHOTOGRAPHS AND MANUSCRIPTS.—Normally, black-and-white photographs and other types of original documents that have faded and are yellowed should be

copied with a film, such as Kodak Commercial film. An original with a weak, faded image should be copied with a film, such as Kodak Contrast Process Ortho.

SPECIAL APPLICATIONS IN COPYING

Special applications are used in copying to detect information that cannot be seen with our eyes under normal lighting conditions. Because these are special applications, they are not performed in most Navy imaging facilities, but are still worth mentioning. These methods involve the use of infrared and ultraviolet radiation and special types of films.

Black-and-White Infrared

Copying with black-and-white infrared films and infrared radiation can help in deciphering old, charred, or altered documents. This is possible because similar appearing materials can reflect and transmit invisible infrared radiation in different amounts. For example, two ink signatures may appear identical to the eye. However, when photographed with an infrared film, the two signatures may appear totally different.

A suitable infrared filter must be used when black-and-white infrared films are exposed. This is because infrared film is sensitive to visible light as well as infrared radiation. The infrared filter absorbs the visible light so the film image is produced entirely with infrared radiation. For specific filter recommendations, consult the data supplied with the film or the *Photo-Lab Index*.

Infrared wavelengths are longer than visible light wavelengths and do not focus on the same plane as visible light. Therefore, a slight increase in lens-to-film distance is necessary. A separate focusing scale for infrared is indicated on the focusing scale of most lenses.

Ultraviolet Radiation

Copying with ultraviolet (UV) radiation can aid in detecting chemically erased or badly faded writing and restoration or alteration of artwork because different materials reflect or fluoresce different amounts of ultraviolet radiation.

Photographing with reflected ultraviolet radiation in total darkness is possible because some of the ultraviolet absorbed by a material may be overlooked as visible light or fluorescence. Such photography in darkness is possible only when a material is illuminated with an ultraviolet source, such as the General Electric Uviarc. The fluorescence from a material illuminated

with ultraviolet radiation should be photographed with a No. 2A (pale yellow) filter to absorb the stronger UV reflections. A recommended film to use for ultraviolet photography is Kodak Contrast Process Ortho film. Exposure tests should be conducted to determine the best exposure for an ultraviolet copy setup.

Do not use commercial ultraviolet lamps in which the lamp itself is an ultraviolet filter. These lamps transmit visible light that does not permit photographing a fluorescing original.

COPYING REFLECTION ORIGINALS

Reflection originals are documents or other flat objects like pictures or drawings that are viewed and photographed (copied) by reflected light.

Copying reflection originals can be done with either horizontal or vertical copy cameras or setups. The size of the copy setup can range from the space necessary to attach the original to a wall and make the copy photo with a tripod-mounted camera, to a copy setup which fills two rooms- one containing the camera back and darkroom and the other the copyboard. Regardless of the different copy setups possible for reflection originals, the copying techniques are the same with few exceptions. In general, the procedures used for copy work are placing the original on the copyboard, aligning the optical axis of the lens with the original, lighting the original, focusing the lens, calculating the exposure, and exposing the film.

PLACING THE ORIGINAL ON THE COPYBOARD

A copyboard should have a positive means of attaching and holding the original. The means of attaching the original could be spring clips, small bar magnets, thumbtacks or pushpins, a hinged glass frame, a sheet of glass, vacuum, and so forth. When thumbtacks or pushpins are used, be sure not to punch holes in the original. For high volume copy, a vacuum copyboard allows a more rapid change and positioning of originals on the copyboard.

When you are using a vertical copy camera or setup, a darkroom printing easel may be used to hold the original in place.

ALIGNING THE OPTICAL AXIS OF THE LENS WITH THE ORIGINAL

Arising, falling, and sliding front feature of a copy camera provides for the alignment of the lens and the

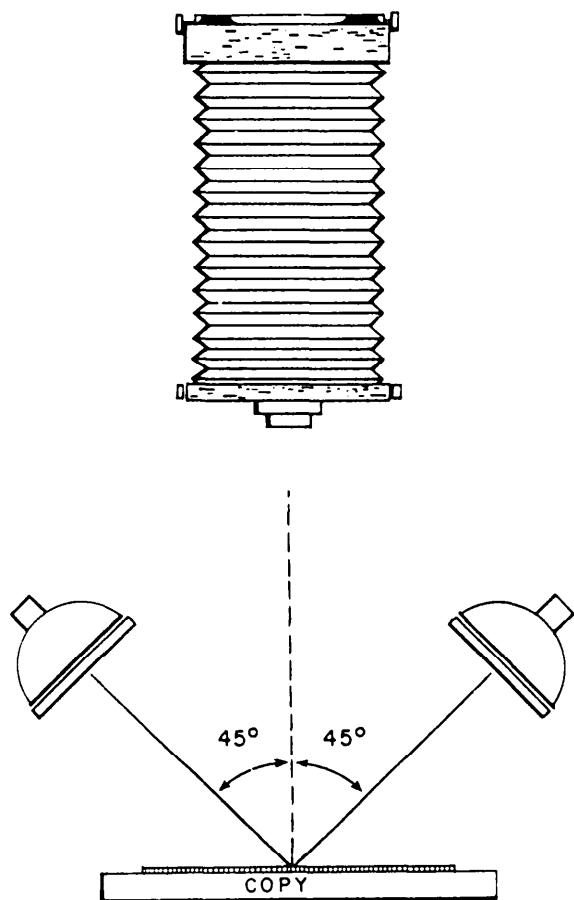


Figure 8-3.—Lights positioned at a 45-degree angle.

original without moving the camera or the original. When the camera is not designed with a rising, falling, and sliding front, the camera or original must be moved to align the original with the optical axis of the lens.

LIGHTING THE ORIGINAL

One of the most important elements in copying is proper, even illumination of the original. Originals that are not properly and evenly lighted yield negatives with uneven density, which are hard to print. This is true whether the original is illuminated by daylight or artificial light. Uneven illumination can be caused by improper placement of artificial lights in relation to the copyboard or by improper placement of the original in daylight.

Artificial lights are normally placed on two sides of the copyboard. A 45-degree angle is recommended for general use (fig. 8-3). At this angle, a minimum of unwanted reflections from the surface of the original occurs. However, depending on the type of surface of the original, the best angle for the lights may change.

For example, an original artwork may have brush strokes that produce reflections. These reflections may be reduced somewhat by placing the lights at an angle greater or lesser than 45-degrees.

Do not position artificial lights too close to the copyboard. The circles of illumination will not cover the original completely. Movable lights should not be positioned so far from the copyboard that the intensity of the illumination falling on the original is greatly reduced.

The evenness of illumination on an original can be checked with an exposure meter. Do this by placing a gray card on the original and taking a reflected light meter reading from the card. Do not allow the shadow of the meter or your hand to influence the reading. When a gray card is not available, a white card (the back of a sheet of photo paper) can be used, but you must compensate your exposure by two f/stops. Reflected light from the four corners and center area of the original should read the same light values.

Daylight provides two choices of illumination: direct sunlight and diffused daylight, such as a cloudy, bright day or open shade. Evenness of daylight illumination is controlled by ensuring that the original is completely in direct sunlight or in diffused daylight, and no shadows are cast on the original.

Although an original is uniformly illuminated over its entire surface, apparent unevenness in illumination may still appear in the copy if a wide-angle lens is used. This is caused when the light transmitted through the center of the lens is more intense than the light transmitted near the edges of the lens. When the entire angle of view of the wide-angle lens must be used, more illumination to the edges of the original is needed to compensate for the falloff of light at the edges of the lens. This can be achieved by turning the lights slightly toward the edges or by moving the lights close to the edges. The amount of light increase necessary for the edges of the original is best determined by conducting exposure tests with the type of film being used.

Lighting control is more critical when using an extremely high contrast film, compared to a high, moderate, normal, or low contrast film. Uneven lighting is more visible in a copy produced with an extremely high contrast film because of the limited exposure latitude of the emulsion.

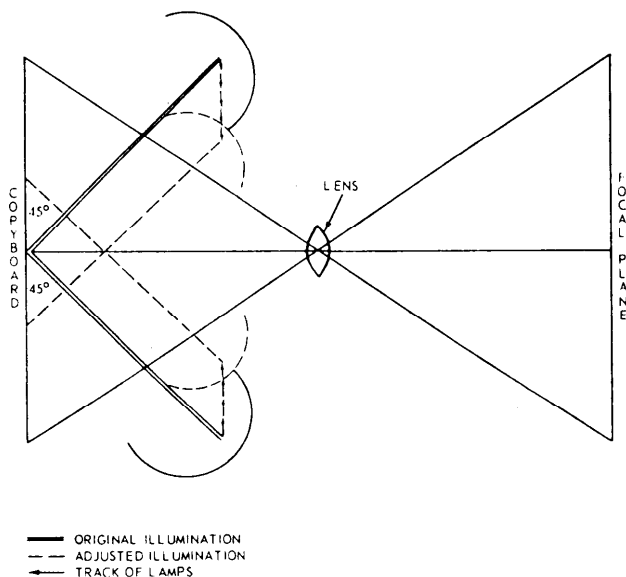


Figure 8-4.—Lighting large originals.

Kelvin Temperature of Illumination

When you are producing color copies, the Kelvin temperature (color) of the light source should match the color balance of the color film being used. When a light source produces an illumination color other than that for which a color film is balanced, filters must be used to alter the Kelvin temperature of the illumination to correspond with the color balance of the film.

Rises and drops in voltage also affect the color temperature and intensity of illumination. Fluctuation in voltage can be controlled by using a voltage regulator.

Lighting Large Originals

For most copy work, you should position the lights at a 45-degree angle, about 36 inches from the copyboard, and aimed at the center of the original. However, there are occasions when you may have to copy a large chart, and the normal lighting setup causes uneven illumination. Light from an artificial source must travel farther to reach the center of the original, and the light reflected from the edges must travel farther to reach the lens. This causes the light to be less intense along the edges and may result in underexposure of these areas. You can correct this condition by adjusting the lights. Keep the lights at a 45-degree angle, but move them closer to the lens optical axis until the light beams from the lamps intersect in front of the original (fig. 8-4). Balance is generally achieved when the beams cross each other at a point approximately one third of the distance from the copyboard to the lens. Check the

lighting on the ground glass or through the viewfinder to see whether it is even from the center to the outer edges.

When lighting large copy, the use of portrait lights with umbrellas is a good source of illumination. The wide coverage and diffused light, produced from this light source, allows you to light the original easily and evenly. To check the evenness of the lighting, use a flash meter and take readings from the center, corners, and intermediate points on the original.

Reflection Control

Unwanted reflections often affect copying. Proper placement of the lights is generally sufficient to eliminate most normal reflections. The three types of unwanted reflections in copy work are as follows:

- Reflections from the light source
- Reflections over the entire surface of the original or copyboard
- Optical flare

Reflections from the light source are caused by light reflecting from the camera stand, lens board, cable release, or other shiny objects around the copy setup. The reflections usually occur when you are copying glass-covered originals, glossy photographs, or other smooth-surfaced originals. The best way to eliminate this type of reflection (when changing the position of the lights does not help) is to use a black cloth or a sheet of cardboard (painted dull black) as a shield between the lens and copyboard. You can do this by cutting a hole the size of the lens in the center of the cloth or board then placing the cloth or board over or around the lens. A lens hood also helps in reducing or eliminating this type of reflection.

Reflections over the entire surface of an original can occur with rough, scratched, crumpled prints or paintings with brush marks, canvas texture, cracks, and so forth. These reflections are caused by high spots on the surface of the original and cause small light reflections of the light source. Such small reflections cover the surface of the original with a haze of light that results in a low-contrast copy image. Reflections of this type are more difficult to avoid than reflections of the light source. As long as the lights shine directly on the rough surface, such reflections occur no matter in what position the lights are placed. There are two lighting methods by which this type of reflection can be minimized or eliminated. These methods are bounce lighting and polarized lighting.

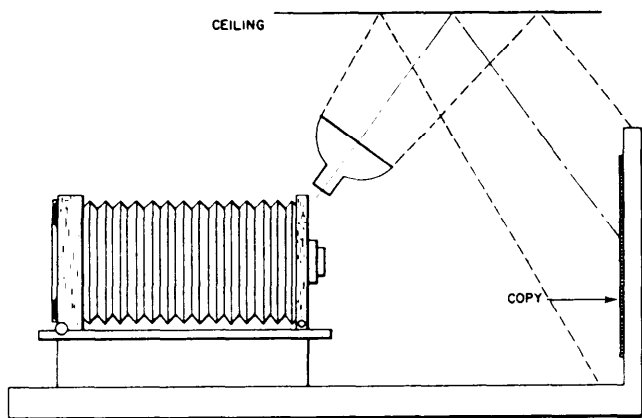


Figure 8-5.—Using bounce light to control reflections.

BOUNCE LIGHTING.—When a white surface is low enough, you should direct the light sources upward so diffused light bounces off the surface onto the original (fig. 8-5). When the surface is too high or other than white, it may be possible to use a white reflector positioned horizontally over the upturned lights. This reflector could be a large sheet of white cardboard.

POLARIZED LIGHTING.—The most efficient method of eliminating unwanted reflections in copy work is by using polarized light. In regular photography, a polarizing filter is placed over the camera lens to subdue reflections. This works because the light from the sun is polarized as it passes through the atmosphere and is reflected by the object being photographed. Using a polarizing filter over the lens only does not greatly reduce unwanted reflections in copy work. In copying, polarizing screens must be used over the lights as well as a polarizing filter over the lens.

When polarized light is used in copying, a considerable increase in exposure is required. This exposure increase is from about 10 to 16 times the normal exposure required with the same lights without polarizing screens. The exact increase is best determined through a series of exposure tests.

Reflections caused by flare are common with dirty or poor quality lenses. When available, lenses designed for copy work should be used, and like all lenses, they should always be kept clean.

DETERMINING EXPOSURE

Like all other types of photography, in copying there are various factors that must be considered when calculating exposure. You must consider the nature of the original—its color and brightness, the intensity of the

light source, the film speed, the filter factor, and the object-to-image ratio or bellows extension

Color and Brightness

Light-shaded or light-toned originals reflect more light than dark originals. Thus, with the same lighting setup, dark originals require more exposure than light originals. The amount of exposure compensation depends on the darkness or lightness of the original. When TTL (through the lens) metering is read directly from the original, a dark original may require twice the exposure of a standard exposure, and a light original may require less than 50 percent of a standard exposure. You should always use a gray or white card to determine the exposure more accurately.

Intensity of Illumination

Intensity of illumination at the copyboard can be controlled by placing the lamps closer or farther from the copyboard, by using lamps of different light intensity output, or by reducing the intensity of illumination by diffusing the light.

The best method for measuring illumination intensity at the copyboard is with an exposure meter. An exposure meter is particularly useful when the copy lights are moved or changed from the positions used to calculate a standard exposure.

The recommended ISO film speeds or exposure indices of copy films apply directly when an incident meter is used or when a reflected meter reading is taken of an 18 percent gray card at the copyboard. When a gray card is not available, a reflected meter reading of a matte white surface with about 90 percent reflectance can be taken. The back of white photo paper provides this reflectance. When a white surface is used to calculate an exposure, the ISO or exposure index of the film should be divided by 5 and rounded off to the nearest setting on the meter. For example: when the ISO is 32, divide by 5 and use 6 or the nearest setting on the meter. You also may take the meter reading directly without changing the ISO and increase the exposure by two f/stops. Remember, exposure meters are calibrated to produce middle gray regardless of the light reflectance ability of the subject. Thus the light reflectance ability of an original should be considered in determining an exposure.

The *exposure indices*, given for high contrast materials used in line copy work, are intended for trial exposures, even when an exposure meter is used.

Exposure Compensation for Bellows Extension

As discussed in chapter 4, an exposure calculated with an exposure meter is precise only for a lens set at a distance equal to one focal length. When the distance between the optical center of the lens and the focal plane is greater than one focal length, an increase to the indicated exposure is usually required. Before an accurate increase in exposure can be applied by opening the lens diaphragm, the effectiveness of the f /stop of the indicated exposure should be determined. Remember, the marked f /stops of a lens that is set beyond one focal length are not valid because the f /stops are a ratio of the diameter of the lens aperture to one focal length. Refer to chapter 4 to determine how to compensate exposure for bellows extension.

PROCESSING COPY FILMS

Films used for copying are processed the same as any other film. They can be processed by machine or by hand, using tanks or trays. Recommendations for specific developers, developing times, and developing temperatures are given with each type of film. Some films not designed specifically for copying may yield negatives with excessive contrast. This can usually be avoided by reducing the developing time. Consult the *Photo-Lab Index* to find suitable developing times to lower or raise contrast.

CATHODE-RAY TUBES

Although taking photographic images from cathode-ray tubes (CRT) is not actually a type of copy work, it has become more commonplace to photograph their images for briefs and presentations. Televisions, computer monitors, and radarscopes all can be classified as CRT photography.

When you are shooting CRTs, like all copy photography, it is important for the optical axis of the lens to be centered and perpendicular to the monitor. The camera must be mounted on a sturdy tripod. A cable release and a macro lens are recommended.

When you are photographing radarscopes, time or shutter speed is not a factor of exposure. The number of sweeps on the scope is the factor that determines the exposure at a given f /stop. The number of rotations is not proportional to film exposure. As a general rule, the exposure doubles between one and three sweeps. To get the correct exposure, you must bracket the exposure. A good starting point for less than three sweeps with ISO 125 film is at $f/5.6$.

To get the sharpest and clearest image possible, you must adjust the brightness of the radarscope correctly. Do this by turning up the intensity until halos appear. Then turn it down until the halos just disappear. When the intensity of the scope is too great, the image appears out of focus. If the intensity of the scope is not great enough, there is little contrast between the video and the background.

Computer-generated graphics are a common means of producing material for use in slide briefings. When available, use a computer monitor with a flat screen rather than a curved screen. Use the same procedures for shooting computer screens that you use for radarscopes. The difference is there is no sweeping motion when shooting a computer monitor or a television. When motion is apparent, you must use a shutter speed of $1/30$ th of a second. When you use this shutter speed, the film records the image without obvious scan lines and stops the motion of the image.

When photographing images from a CRT, always darken the room before you make the exposures. This prevents glare on the screen and only the illumination from the screen affects the film.

SLIDE DUPLICATING

In photography, you must often make duplicate slides from an original. Duplicating is actually a form of copying. A duplicate or “dupe” can be made to almost any desired size. Contrast and density along with color adjustments can be made when duplicating color slides.

Color slides are duped to provide extra copies of the slide, correct color balance and contrast errors, or even to change or enhance colors for special applications.

CAMERAS AND ACCESSORIES FOR DUPLICATING

Except for the copyboard or easel, the features of the equipment used for duplicating transparent originals are essentially the same as that used in copying reflection originals. The exception being that the copyboard for copying transparent originals must allow light to be transmitted through the original to the camera.

Except for being lit by transmitted light, large format transparent originals (larger than 35mm) are copied the same as reflection originals. 35mm transparencies are copied with special slide copying attachments for cameras, or copied in specially designed, semiautomatic or automatic slide copiers.



302.185

Figure 8-6.—Slide duplicating system.

Regardless of the equipment being used, your goals for duplicating transparent originals should be to duplicate, improve, or alter, as desired, the reproduction of the original.

DUPLICATING 35mm COLOR SLIDES

To get additional copies of a color slide, you must either make several exposures of the original scene or make duplicates from the original slide. When the scene cannot be re-photographed, the only alternative is to make duplicates of the original slide.

Other than making a number of duplicate slides from an original, you can use the duplicating process to improve a photograph. The image can be made larger or smaller, the composition can be changed through cropping, the density of the duplicates can be changed from the original, and with the use of filters, the color of the reproductions can be changed.

In most Navy imaging facilities a camera designed especially for copying slides is used (fig. 8-6). This

camera setup usually consists of a unit having a camera body and lens, bellows extension, light source, a copyboard, filter holders, and the necessary controls and switches. When slides are copied with a slide duplicating camera, the slide is transilluminated. This is the most common method of copying slides.

Exposure

Whatever method you use to copy slides, you must make exposure tests. The original slide you choose to make the tests should have average density and brightness and normal contrast. This slide should be retained as a reference slide. A full-frame slide of a color rendition chart (color checker) serves ideally as a reference slide. A color rendition chart allows you to visually or objectively compare a series of colors and densities of the original reference slide against the slide duplicate. To visually compare slides, you should use transmitted light and color viewing filters to judge the slides. The objective method is more accurate. A densitometer is used in this method. A densitometer is an electronic meter that measures the actual density of black-and-white and color materials.

Kodak Ektachrome slide duplicating film is recommended for slide duplication. This film is manufactured to provide lower contrast, less filtration with tungsten lighting, and it has good color reproduction characteristics.

The data supplied with the slide duplicating film or the *Photo-Lab-Index* provides information that you can use as a starting point for exposure tests. However, you should bracket the exposure at least one f/stop in one-half f/stop intervals on each side of the basic exposure.

Slide Handling

The original slide must be clean to produce high-quality duplicate slides. The smallest piece of dust or lint is magnified greatly when the slides are projected. Never touch a slide with your fingers. Handle the slides only by their mounts. Hold unmounted transparencies only by the edges. Dust or lint should be removed with low-pressure air or a camel-hair brush. If there are fingerprints or oily smudges on the slide, you can remove them with a soft, lint free pad or a piece of cotton dampened with film cleaner.

Slides should be placed in the slide duplicator base-side up. When you are duplicating the full frame

of the slide, you must place the slide on the copy stage horizontally, regardless of the composition of the slide. When a full frame view is not desired, you can crop or enlarge a portion of the original slide. When you change the camera or lens distance to alter the image size, be sure to refocus the image.

Examining Results

The duplicate slide should be laid on a light table and compared to the original. If you bracketed your exposure, determine which exposure provides the correct density. When none of the exposures are correct, the original must be recopied and given more or less exposure by changing the f/stop. The exposure time should not be changed. Again, bracket your exposure.

Color Balance

Color compensating (CC) filters are used in a slide duplicating camera. The CC filters are placed between the original and light source. By changing the filtration, you can correct the color balance of the duplicate slides.

After producing a duplicate slide with proper density, the color balance of the duplicate slide must be evaluated. When the color balance is off, you must change it through the use of CC filters and re-shoot the original. When the duplicate is extremely yellow, first check the slide duplicating light source. Most slide copy systems using tungsten light, have a "view setting" and a "filter setting." If the system was set in the view position, the CC filters were not in place. The unfiltered tungsten light produces a slide that is very yellow.

To judge the color balance of the duplicate slide, lay it on a light table, compare it to the original, and determine what color or colors are in excess. To do this, you should view the duplicate slides through various CC filters. A color print viewing kit is convenient for this purpose. When viewing slides through the various filters, look at the midtones, not the shadows or highlights. Color viewing filters are helpful in making color balance determinations. If a color rendition chart was used as the original slide, a densitometer can be used to directly compare the color balance of the original to the duplicate.

To adjust the filter pack for the color in excess in the duplicate slide, you should either subtract filtration of

Table 8-1.—Color Compensating Filter Factors

FILTER	FACTOR	FILTER	FACTOR
05Y	1.1	05R	1.2
10Y	1.1	10R	1.3
20Y	1.1	20R	1.5
30Y	1.1	30R	1.7
40Y	1.1	40R	1.9
50Y	1.1	50R	2.2
05M	1.2	05G	1.1
10M	1.3	10G	1.2
20M	1.5	20G	1.3
30M	1.7	30G	1.4
40M	1.9	40G	1.5
50M	2.1	50G	1.7
05C	1.1	05B	1.1
10C	1.2	10B	1.3
20C	1.3	20B	1.6
30C	1.4	30B	2.0
40C	1.5	40B	2.4
50C	1.6	50B	2.9

the color in excess or add filtration of the complimentary color to the color in excess. The amount of change required is about the same as the viewing filter required to make the midtones appear correct.

For example, when a slide is over in blue and requires a CC20 yellow viewing filter to make the midtones appear correct, a CC20 blue filter should be subtracted from the filter pack. When a CC20 blue filter cannot be removed, a CC20 yellow filter should be added to the filter pack. Your first choice should **always** be to subtract rather than add.

Adding or subtracting filters has an effect on exposure. To determine the exposure change required, you should refer to the operating instructions for the slide copier or consult a CC/CP filter factor table (table 8-1).

The number of filters used in a filter pack should be kept to a minimum. Do not combine all three filters. This only creates neutral density.

After processing, select the best exposure and use it as the basic exposure for future duplicates. When you copy other slides that are darker or lighter than the reference slide, adjust the basic exposure. Use one-half

or one f/stop more exposures for slides that are darker than the reference slide, and one-half or one f/stop less exposure for slides that are lighter than the reference slide.

You should maintain a log of the different types of copy jobs completed in your area of responsibility. With the continual changes in photographic film, processes,

and equipment, you must always perform tests (whether it be standard copy or slide duplication) to achieve the highest quality product possible. Camera distance, light source (K), light distances, film type, filters, camera settings, and processes should all be included in the log. By maintaining a log, you eliminate the necessity for photographic testing every time a routine copy job comes into your work center.